Towards a pedagogy of supervision in the technology disciplines

STUDENT RESOURCES FOR THE USE OF SUPERVISORS

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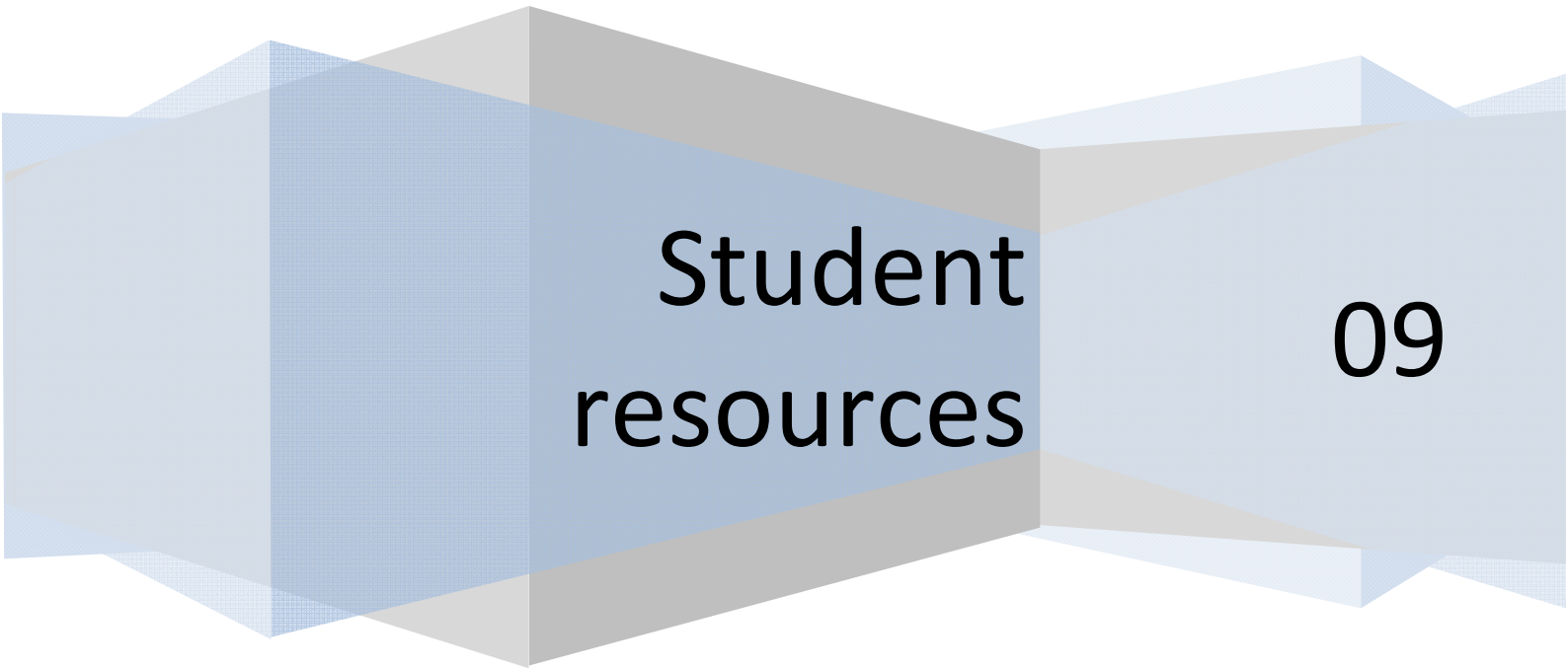

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INTRODUCTION TO STUDENT RESOURCES FOR THE USE OF SUPERVISORS

The materials presented here are intended to:

a) accompany the document *Supervisor Resource* and
b) provide technology supervisors with materials that may be readily shared with students.

These resources are not designed to be distributed to students without contextualization, they are intended for use in workshops or in discussions between supervisors and students. As authors, we anticipate that supervisors or workshop facilitators are most likely to extract individual resources of interest for particular occasions.

The materials have been developed from conversations with supervisors from the technology disciplines.

Further information of interest appears in a side bar.

READING THIS DOCUMENT

We have designed this document to make it easy to read. We have consistently used particular devices for the same purpose:

Things for readers to consider appear in arrows like this.

Quotes from supervisors talking about their supervision appear in blue boxes.

Throughout this resource direct quotes from conversations with supervisors are followed by reference to a specific interview ("I") or workshop ("W"). For example, "(I2)" means the quote is from Interview 2. Also indicated is the discipline to which the supervisor belonged.

The banners refer you to additional resources that might help.

"Quotes like this identify more things that supervisors have said."

CONTENTS

FRAMEWORK FOR THINKING ABOUT SUPERVISION IN THE TECHNOLOGY DISCIPLINES (SHORT)

Supervisors see teaching research students as	Supervisors primarily see research as	Supervisors primarily see students learning to research as	Supervisors' suggested roles	Curriculum orientations
Supervisors: a) may 'locate' supervision in different parts of the framework in different contexts; b) are unlikely to ever adopt only one frame, but are more likely to blend more than one frame in response to variables like the student's need, the topic, the stage of candidature; c) may emphasise, or prefer to identify with, particular parts of the framework; and d) may choose to adopt aspects most appropriate to circumstances.				
Upholding academic standards *Meeting the discipline and institutional communities' expectations*	**Substantial** *Working rigorously on difficult problems, resulting in important breakthroughs*	**Accepting constraints** *Disciplined application of basic skills to new areas*	Manager	Academic discipline
Imparting academic expertise *Conveying expertise in research processes*	**Investigative** *Strategic, evidence-based problem solving*	**Being apprenticed** *Imitating a master*	Manager	Competency
Promoting learning to research *Meeting students' learning needs*	**Meaning-making** *Seeking meaning through the synthesis of complex data or knowledge*	**Journeying** *Self-discovery by trial and error, towards independence*	Coach	Learning to learn
Promoting the supervisor's development *Pursuing the supervisor's established objectives*	**Deepening** *Increasing self awareness through an iterative process*	**Focussing** *Pursuing mature, world-class expertise*	Director	Personal relevance
Enabling student development *Seeking students' academic and professional maturity*			Nurturer	
Contributing to society *Meeting society's needs*	**Productive** *Usefully satisfying a range of stakeholders*	**Contributing** *Exploring positive impact on others*	Partner	Social impact
Venturing into unexplored territory *Discovering the research agenda together*	**Explorative** *Following speculative leads which challenge norms*	**Stretching** *Being stretched into new areas*	Colleague	Collaborative
Drawing upon student expertise *Building from existing student abilities*			Guide	
Forming productive communities *Drawing key stakeholders together*			Colleague	

FRAMEWORK FOR THINKING ABOUT SUPERVISION IN THE TECHNOLOGY DISCIPLINES (LONG VERSION)

Pedagogies		Supervisors' approaches	Sample learning outcomes	Supervisors primarily see research as	Supervisors primarily see students learning to research as	Supervisors' suggested roles	Curriculum orientations
Supervisors see teaching research students as	Supervisors direct attention towards						
Upholding academic standards *Meeting the discipline and institutional communities' expectations*	Established academic standards	• Scaffolding • Direction-setting	• quality publications • topic expertise	**Substantial** *Working rigorously on difficult problems, resulting in important breakthroughs*	**Accepting constraints** *Disciplined application of basic skills to new areas*	Manager	Academic discipline
Imparting academic expertise *Conveying expertise in research processes*	Supervisor's knowledge and skills	• Scaffolding • Relationship	• academic writing • literature review • technical skills	**Investigative** *Strategic, evidence-based problem solving*	**Being apprenticed** *Imitating a master*	Manager	Competency
Promoting learning to research *Meeting students' learning needs*	Students' learning needs	• Scaffolding • Relationship	• to become an expert • reflection • study habits	**Meaning-making** *Seeking meaning through the synthesis of complex data or knowledge*	**Journeying** *Self-discovery by trial and error, towards independence*	Coach	Learning to learn
Promoting the supervisor's development *Pursuing the supervisor's established objectives*	Supervisor's research agenda	• Direction-setting	• join established team • enter supervisor's projects	**Deepening** *Increasing self awareness through an iterative process*	**Focussing** *Pursuing mature, world-class expertise*	Director	Personal relevance
Enabling student development *Seeking students' academic and professional maturity*	Student maturity	• Relationship	• mature researcher • question status quo			Nurturer	
Contributing to society *Having social impact*	Society's needs	• Direction-setting • Relationship	• develop innovative solutions	**Productive** *Usefully satisfying a range of stakeholders*	**Contributing** *Exploring positive impact on others*	Partner	Social impact

Pedagogies							
Supervisors see teaching research students as	Supervisors direct attention towards	Supervisors' approaches	Sample learning outcomes	Supervisors primarily see research as	Supervisors primarily see students learning to research as	Supervisors' suggested roles	Curriculum orientations
Venturing into unexplored territory *Discovering the research agenda together*	New frontiers	• Direction-setting • Relationship	• employ out-of-the-box thinking	**Explorative** *Following speculative leads which challenge norms*	**Stretching** *Being stretched into new areas*	Colleague	Collaborative
Drawing upon student expertise *Building from existing student abilities*	Student's contribution	• Relationship	• become world expert • teach the supervisor			Guide	
Forming productive communities *Drawing key stakeholders together*	Community's contribution	• Direction-setting • Relationship	• develop networks • span disciplines			Colleague	

Note: As supervisors… a) may 'locate' supervision in different parts of the framework in different contexts; b) are unlikely to ever adopt only one frame, but are more likely to blend more than one frame in response to variables like the student's need, the topic, the stage of candidature; c) may emphasise, or prefer to identify with, particular parts of the framework; d) could deliberately choose to adopt aspects most appropriate to circumstances.

THE NINE PEDAGOGIES OF SUPERVISION

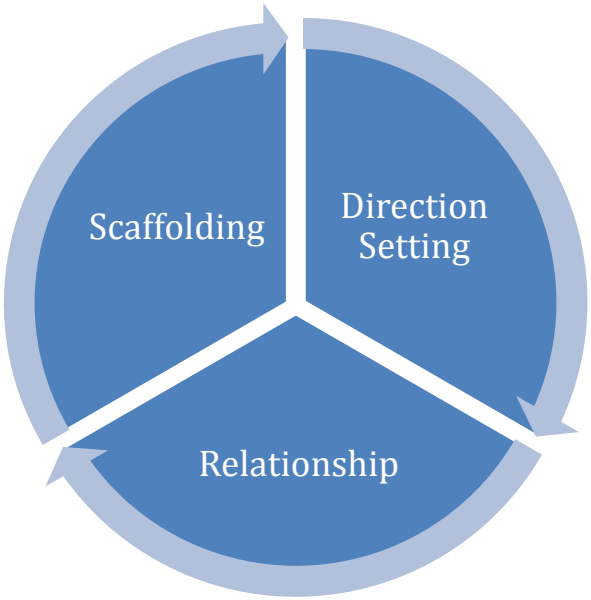
Technology supervisors may use any of nine different ways of thinking about teaching and learning in supervision (the 9 Pedagogies).

9 Pedagogies (ways of thinking about teaching and learning in supervision in the technology disciplines)	Summary description
Upholding Academic Standards	Meeting the discipline and institutional communities' expectations
Imparting Academic Expertise	Conveying expertise in research processes
Promoting Learning to Research	Meeting students' learning needs
Promoting Supervisors' Development	Pursuing the supervisor's established objectives
Enabling Students' Development	Seeking students' academic and professional maturity
Contributing to Society	Having social impact
Venturing into Unexplored Territory	Discovering the research agenda together
Drawing upon Student Expertise	Building from existing student abilities
Forming Productive Communities	Drawing key stakeholders together

These pedagogies are described in more detail in *The 9 Pedagogies* section of this resource.

APPROACHES

There are three approaches that supervisors might adopt when supervising.



Often they adopt a blend of these approaches.

The extent to which any one dominates could be said to reflect their personal approach.

SCAFFOLDING

When adopting a **scaffolding approach** supervisors emphasise the procedures.

The scaffolding approach is concerned with the need for structure for students, especially around project management to encourage systematic progress. Supervisors may, for example, provide structure early in the candidature by clarifying the student's role, devising a monthly plan and developing an overview of the thesis. They would ensure outputs through regular reporting, and early journal and conference writing.

DIRECTION SETTING

When adopting a **direction setting approach**, supervisors emphasise research objectives and outcomes.

The direction-setting approach is concerned with the need to give clear guidance to students, in terms of the goals of their candidature. Supervisors may, for example, incorporate new students into their established research programmes, prompt students to assess their project objectives in the light of their workgroup context, or establish goals that they can mutually agree on.

RELATIONSHIP

When adopting a **relationship approach**, supervisors emphasise personal interactions.

The relationship approach is concerned with the interactions and needs of the people involved in supervision. They may, for example, establish learning communities by learning with the student, forming a substantive relationship with them, and encouraging work with other students and industry partners.

Establishing collaboration

So, in summary, it's about forming a substantive human relationship… That has to be continually refreshed and out of that there is a respect.

Some students like to meet regularly and they want to talk a lot, and others you understand that they want to go away and they don't want you to bother them.

Then there are others who might go away but they don't come back, so you have to keep checking in the early stages how they are travelling.

Some are not very introspective about what's going on or are not assertive enough at least in the early stages until you've got an established relationship which allows communication to happen. (I16)

STRATEGIES

Supervisors use a wide range of strategies. Some of these are listed below.

STRATEGY A. CREATING GROUPS

Drawing key players together for conversation, on a regular basis, using:

- Small groups – single student (held weekly, fortnightly or monthly)
  - One supervisor and one student meet on a fortnightly basis, with the student bringing their progress on an assigned writing project.
  - One or two supervisors and one student meet on a monthly basis, with the student bringing questions that have arisen.
- Larger groups – many students (held weekly, fortnightly, monthly or annually)
  - Weekly reading groups, led by the students.
  - Monthly discussion groups where students bring questions, open to any students (not just those supervised by the academic present).
  - Monthly seminars, with many students, supervisors and industry partners, where students present short papers.
  - Annual mini-doctoral consortia, where many students present their work to a panel of supervisors.
- Groups outside the university
  - Students present peer-reviewed papers at conferences.
  - Students attend summer schools, to acquire specific skills.

Which strategies have you experienced? Which strategies seem useful or interesting to try? What do you like or dislike about them?

STRATEGY B. CREATING STRUCTURE

Project managing or planning, with an emphasis on the process, establishing:

- early clarity about responsibilities;
- goals of the project and supervisor/student responsibilities;
- monthly plans, especially for first year students;
- project objectives for this period and associated tasks;
- early development of a Table of Contents and an Abstract;
- headings and subheadings with descriptive sentences, which are progressively expanded into full chapters;
- regular reporting, for example monthly; and
- standard forms which cover the essential aspects, then work through these in a meeting.

The first year is very important, especially the first half year, I think. So normally at the very beginning I ask the students to make a plan. I want them to control their time because we have three months before something is due. I ask them to give me a plan, month by month, and the first month week by week. (I11-2 –IT)

STRATEGY C. GENERATING OUTPUTS

Ensuring timely deliverables, the outcomes aspect of project management, for example:

- representing the study as a project that has an end;
- identifying an examinable thesis as the ultimate goal;
- commencing outputs early; and
- submitting to realistic events, such as lower level conferences.

I tell them when they are even 50% happy with something or they have come to a point where they don't know what direction to take, "Give it to me" because I don't want them to try to figure it out and then find it's a completely wrong direction. So I try to see drafts and I try to see their thoughts very early before they are emotionally committed to them. (I20 – Engineering)

STRATEGY D. CREATING SPACE

Providing intellectual space, reducing structure to allow creativity and inspiration, for example:

- have open conversations, to help discover the possibilities;
- withhold critical comment to allow speculative thinking;
- give students the opportunity to make their own discoveries; and
- indicate the way to find the answer to a question, rather than give the answer directly.

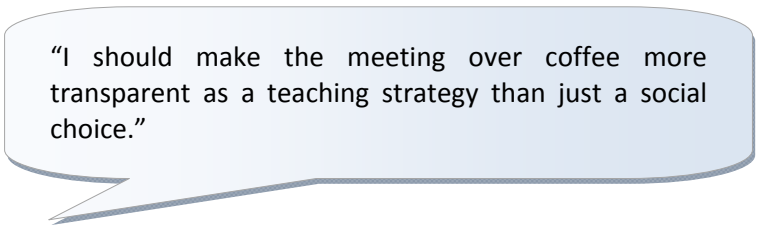
It's the esoteric thoughts that you really need in research. You need the wacky thoughts, "Why don't we try looking at it this way?" If you're not comfortable, you're only going to say things that are safe. (I13 – Engineering)

STRATEGY E. ESTABLISHING COLLABORATION

Forming learning communities, with the student as a colleague, for example:

- learn with the student, work side by side with them;
- learn to use a new laboratory instrument together;
- form a substantive relationship with the student;
- explore new thoughts together, through open speculative discussion, perhaps during informal lunch meetings;
- encourage collaborative work with other students; and
- situate a student in a like-minded group or in a team working on a common project.

You create a bidirectional flow whereby… this organization has a very dense network... You have all these dots, but all these dots are very well connected… there is a maximum density in this network. Every single student is another bouncing partner for all the other PhD students in that network. (I12-2 – IT)



Considering the students' career goals

A student has recently informed me, fairly late in the game, that they want to pursue a consulting career.

So I want to try to ensure that they have the necessary breadth and range of understanding in order that they can interact with practitioners…

not just go deep into esoteric academic topics but rather ensure that they know the means of evaluation that are used in practice and then emphasize that in the thesis.

We can ideally tailor the student's experience to some degree, in the light of their career aspirations. (I12)

STRATEGY F. FOCUSSING ON THE BIG PICTURE

Incorporating the context of the candidature, the long-term objectives, for example:

- consider the student's career goals;
- provide teaching opportunities, if student is pursuing an academic career;
- factor in the student's and supervisor's strengths and weaknesses; and
- match a student who requires significant mentoring with a supervisor who is able to offer this level of engagement.

I often have conversations with students about what they want in terms of a career and we try to somehow take that into consideration in devising their programme of activities. (I12-1 – IT)

STRATEGY G. NEGOTIATING EXPECTATIONS

Setting up the programme for success, by establishing high standards, for example:

- early establishment of clear expectations;
- draw up a supervision contract, outlining university's expectations of the student, including the student's growing independence;
- only accept candidates who display a satisfactory proficiency; and
- screen applicants to choose only high quality students who are interested in the supervisor's research group's topic area.

I get people to send me some writing before I take them on so I can see their basic level. So, making sure that the students who come in are actually ready for a PhD level. (I20 – Engineering)

STRATEGY H. PURSUING ESTABLISHED PROGRAMMES

Contributing to previously determined research agendas, including:

- inserting students into supervisor-defined, established programmes of research; and
- placing students in established programmes, to advance those programmes' agendas.

Generally the way I do work with students is that during the first year they are probably working as a research assistant, learning the ropes. This is what you have to do, you have to do the literature review and this is the kind of program you will have to write and this is how we are going to test it, etc. (I1 – IT)

QUT Graduate Capabilities

THINKING
- advanced theoretical knowledge and analytical skills, as well as methodological, research design and problem-solving skills in a particular research area.

RESEARCH MANAGEMENT
- independence in research planning and execution, consistent with the level of the research degree/researcher.

INFORMATION MANAGEMENT
- advanced information processing skills and knowledge of advanced information technologies and other research technologies.

ENTERPRISE
- awareness of the mechanisms for research results transfer to end-users, scholarly dissemination through publications and presentations, research policy, and research career planning.

RESEARCH CONDUCT
- competence in the execution of protocols for research health and safety, ethical conduct and intellectual property.

COMMUNCIATION
- skills in project management, teamwork, academic writing and oral communication.

LEARNING OUTCOMES

Supervisors seek many learning outcomes from the HDR candidature. The table below presents an overview of some learning outcomes expected of research students. The learning outcomes are shown in connection with the pedagogies that they are associated with.

Some learning outcomes sought by supervisors

Some learning outcomes	Supervisors see teaching and learning research students as
• discipline, to be hard workers • knowledge about academia • quality publications, indicating a complete project • topic expertise • discipline expertise • approaching findings with scepticism • rigour *I would like them to become like… Isaac Newton... one of the reasons I think that he was so effective in making groundbreaking answers was that he was both very thorough and very diverse… that enabled him to... make linkages. (I2 – Engineering)*	**Upholding academic standards** *Meeting the discipline and institutional communities' expectations*
• how to conduct research... using my approach • how to do a literature review • what doing research means • a scientific method, how to lead an experiment and give an account in the proper way • ability to publish • how to get resources • project management • how to present succinctly • ability to write academically • how to write for different audiences • how to sell their topic • about the process of being a rigorous investigator • how to ask questions and think creatively *I expect them to learn a lot about the process of being a rigorous investigator and along the way they learn about their topic... The topic I think is almost less important in my mind. (I9 – IT)* *They've got to learn how to write, because if they can't write, they can't write publications, so it doesn't matter if they can do the experiments because if they can't write they're not doing research, as simple as that. (I3 – Engineering)*	**Imparting academic expertise** *Conveying expertise in research processes*
• to become a devil's advocate • how to become an expert • that research is difficult… that a PhD is frustrating • reflection skills • developing study habits *They all need to learn that a PhD is frustrating, that it's a long, slow process. (I5 – Engineering)*	**Promoting learning to research** *Meeting students' learning needs*

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- skills in project management, teamwork, academic writing and oral communication.

Some learning outcomes	Supervisors see teaching and learning research students as
• fit into an established research team • contribute to supervisor's projects *during the first year they are probably working as a research assistant, learning the ropes… you have to do the literature review and this is the kind of program you will have to write and this is how we are going to test it… (I1 – IT)*	**Promoting the supervisor's development** *Pursuing the supervisor's established objectives*
• learn about themselves • develop as a person • develop a passion for research • have confidence • how to organize themselves, their thoughts • entrepreneurial and leadership skills • an independent, mature researcher in their field • ability to stand on their own and question the status quo *I'd like them to have the courage to approach things from unorthodox ways, if necessary. So, a kind of independence of thought and not being afraid to go out on a limb, but to do that responsibly. (I16 – IT)* *getting very deeply into an area is I think very useful for students, for them to understand better about the world in general. How much you know and how much you don't know… I think that helps grow one's understanding maybe in all spheres of life. (I19 – IT)*	**Enabling student development** *Seeking students' academic and professional maturity*
• to develop substantial and innovative solutions • contribution to society through research *I do try to make sure that students are aware of the overriding consideration of trying to advance knowledge and that should be, in ethical terms, something that guides how we do research. (I19 – IT)* *to create ground-breaking systems that help other people (W2)*	**Contributing to society** *Meeting society's needs*

The Graduate Capabilities are QUT's formal set of research student outcomes. They are listed on the Research Student Centre website with links to appropriate training. See *Have you used the following resources that help?* section of this resource.

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- skills in project management, teamwork, academic writing and oral communication.

Some learning outcomes	Supervisors see teaching and learning research students as
• creation of innovative systems • employ courageous, out-of-the-box thinking *learn things that are difficult and innovative, create their own very substantial solution… And… solutions to complex problems, as well, not just simple ones. (I2 – Engineering)*	**Venturing into unexplored territory** *Discovering the research agenda together*
• become the world expert • teach the supervisor *I expect them to come out at the end of the three year period able to run rings around me in the particular project area that they are doing. I want to learn from them and I want them to understand that I want to learn from them. (I22 – IT)*	**Drawing upon student expertise** *Building from existing student abilities*
• to develop an international network • team work skills and membership in a research community • to work effectively with others • work across discipline boundaries *a student who is a couple of years in is almost taking someone under their wing, someone who is a little newer. In some ways the more experienced student is bridging the gap between you and the new student. (I14 – IT)*	**Forming productive communities** *Drawing key stakeholders together*

The Australian Technology Network LEAP module on:

- 'Communication' may be useful in forming productive communities.
- 'Entrepreneurship' may be useful in venturing into unexplored territory.

See the *Have you used the following resources that help?* section of this resource.

The most influential investigation into researchers' experience of research was conducted by Angela Brew (2001), who describes **four variations in the experience of research.**

1. In her *domino conception,* research is seen as separate tasks or events that impact on one another. These individual separate elements are the focus of researchers' attention, and need to be synthesised as part of the research process.
2. In her *trading conception,* research is seen as a social phenomenon with focus on research products such as publications and grants.
3. In her *layer conception,* researchers focus on their data and discovering the meanings embedded there.
4. In her *journey conception,* researchers are aware of themselves as researchers and the influence of their research on themselves and society.

VIEWS OF RESEARCH

Supervisors view research and learning to research in various ways.

RESEARCH IS SEEN AS SUBSTANTIAL

It is about working rigorously on difficult problems, resulting in important breakthroughs.

Some key ideas associated with this view are: Substantial ideas, tackling difficult problems, finding solutions, arriving at an informed view, sound methodology, 'good' results, rigor, hard work, disciplining the mind, intensive.

It's an intense, full-on occupation, being a researcher. (I1 – IT)

It's not really just about mimicking, it's about coming up with new ideas, new and substantial ideas. So, we start talking to them about vision because you need to have a vision to get to that place where you can be a substantial researcher. (I2 – Engineering)

they've got to learn the rigours, that badly done research is pointless and so if they are working with an engineer and it frustrates them that they have to spend so much time designing an experiment or a technique, that they understand that that is valuable at the end of the day. If you're going to do it, you've got to do it properly. (I5 – Engineering)

What do you, your supervisor or your peers have to say about this view?

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RESEARCH IS SEEN AS INVESTIGATIVE

It is about strategic, evidence-based problem solving.

Some key ideas associated with this view are: Problem-solving techniques, persistence, being systematic, strategies for understanding, obtaining relevant resources, evidence-based.

Because we work in science so they have to learn a scientific method of research. So, trial and error, to try a certain experiment, see if the experiment is successful, if it is not successful try to find answers. (I4 – Engineering))

Persistence is high on the list. Not giving up too soon. Being willing to try the 401 things that didn't work, before you got to the one that does work. Being systematic, in the sense that your research is replicable by somebody else. (I14 – IT)

What do you, your supervisor or your peers have to say about this view?

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Bowden and Marton (1998) describe collective awareness in relation to learning as "the degree of awareness among teachers and students of the other's ways of seeing", and researchers' collective awareness as "the degree of awareness amongst researchers and graduate students of the others' ways of seeing" (p. 196).

Senior academic administrators in universities have been found to view research as being diverse but having the main attributes of:

1. the creation of new knowledge, implying building on what is already known;
2. enquiry, involving systematic and sceptical reflection on knowledge; and
3. the publication of results, including submission to peer review.

This was accompanied by the notion of scholarship which contributed a breadth of viewpoint and the sustained pursuit of a line of research (Neumann, 1993).

RESEARCH IS SEEN AS MEANING-MAKING

It is about seeking meaning through the synthesis of complex data or knowledge.

Some key ideas associated with this view are: Gaining insight, finding solutions.

I expect them to learn how to... how to solve problems on their own... create their own very substantial solution... and innovative solutions... solutions to complex problems (I2 – Engineering)

I expect them to learn how to think, to critically analyse the problem, to come up with a variety of solutions, and to narrow that down. (I13 – Engineering)

What do you, your supervisor or your peers have to say about this view?

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RESEARCH IS SEEN AS DEEPENING

It is about increasing self awareness through an iterative process.

Some key ideas associated with this view are: Iterative, narrowing focus, deepening self, understanding your own contribution.

To work their way into the topic and to identify what they think are the key issues that they need to resolve (I3 – Engineering)

They… learn about themselves… it's an exercise in discipline, it's an exercise in organisation, it's an exercise in hard work and frustration… research is difficult… and never is as simple as it looks. (I5 – Engineering)

The students have to sort of embody this themselves… there is a guidance… modulated by the student and their strengths and weaknesses… providing them with enough so that they can start an internal process whereby they start manifesting themselves. It's not an externally driven sort of thing… you walk together and then suddenly it's like they hit a gear and then they start going off doing things and finding that they have the confidence to do that. They sort of launch off. (I16 – IT)

What do you, your supervisors or your peers have to say about this view?

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Kiley and Mullins (2005) found that research supervisors view research as :

- technical;
- applying systematic techniques;
- creative and innovative;
- integrating complexity;
- synthesising complex data or knowledge; or
- bringing about new ways of seeing.

RESEARCH IS SEEN AS PRODUCTIVE

It is about usefully satisfying a range of stakeholders.

Some key ideas associated with this view are: Useful to industry, satisfying stakeholders, commercial value.

Doing research… means publishing research outcomes. (I3 – Engineering)

Some of them have industry sponsors either sponsoring research or as a source of evidence for the research and I basically said to them, "It is your responsibility to ensure that this sponsor organization gets value for what you are doing." (I12-1 – IT)

The overriding consideration of trying to advance knowledge… should be, in ethical terms, something that guides how we do research. (I19 – IT)

What do you, your supervisors or your peers have to say about this view?

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RESEARCH IS SEEN AS EXPLORATIVE

It is about following speculative leads which challenge norms.

Some key ideas associated with this view are: Newness, following leads, thinking outside the square, big risks leading to big steps, exploring esoteric thoughts, asking big questions, questioning norms.

To have the courage to approach things from unorthodox ways… So, a kind of independence of thought and not being afraid to go out on a limb, but to do that responsibly. Of course… you become part of a field and that field has its own norms but still to be aware that you are not to be trapped by that. (I16 – IT)

The nature of the research that we do is that we have to be somewhat reactive according to what happens. We may try to solve a particular problem but it may not come out as we expect… depending on how it develops we might say, "This is really promising we'll go further with this and push the rest of the plan aside accordingly." (I19 – IT)

What do you, your supervisors or your peers have to say about this view?

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Students (women in Australia and South Africa) see research as:

- *the gathering of information*, including the collection of data for analysis;
- *discovering truth,* seeking out the truth or establishing the truth about something;
- *an insightful process,* deepening or extending our understanding of existing knowledge;
- *re-search,* returning to previous research and making new findings; and
- *finding solutions to problems*, or answering questions

(Meyer, Shanahan & Laugksch, 2005)

VIEWS OF LEARNING TO RESEARCH

LEARNING TO RESEARCH IS SEEN AS ACCEPTING CONSTRAINTS

It is about disciplined application of basic skills to new areas.

Some key ideas associated with this view are: Developing habits, applying basic skills, methods and tools (to new problems), disciplining the mind, applying a high work ethic, grasping fundamentals, constructing an argument, interrogating existing research, seeking out resources, structuring any topic.

You have to learn a number of techniques depending on the field you are working in and you have to master these techniques in order to give a result that is at an international level (I4 – Engineering)

What do you, your supervisors or your peers have to say about this view?

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LEARNING TO RESEARCH IS SEEN AS BEING APPRENTICED

It is about imitating a master.

Some key ideas associated with this view are: Imitation, apprenticeship, following a model, walking alongside a researcher (initially), following expert advice, understanding process and standards.

The preferred model for me is master/apprentice, when you're at the coalface together and working on the details together. (I16 – IT)

I guess it is the master-apprentice approach, where you basically teach them how you do it. (I1 – IT)

What do you, your supervisors or your peers have to say about this view?

……

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Students report that learning to research involves:

- recognising alternative epistemological stances;
- seeking to understand the basis of others' perspectives;
- realizing differences in the fundamental nature of learning;
- engaging in personal reflection and appreciating its role in interpretation; and
- understanding and realizing differences in the nature of professional practice

(Wood, 2006)

LEARNING TO RESEARCH IS SEEN AS JOURNEYING

It is about self-discovery by trial and error, towards independence.

Some key ideas associated with this view are: Working into the project, learning about self, discovery by trial and error, learning to choose focus, stumbling journey (with excellent hindsight), climbing by yourself (with encouragement and guidance), developing independence, being self-starting and self-monitoring, linking broad and deep knowledge, tolerating rejection and learning from it, learning to choose which advice to listen to.

Students have to learn about themselves that they can take a subject, understand it and develop it and learn a level of independence (I5 – Engineering)

I expect a PhD student to be a little bit more self-directed and prepared to learn the method. They have a little more time… to complete the work, so let them learn by trial and error. (I8 – IT)

There's a big difference between the beginning and the end of the PhD... I expect them to take more and more responsibility as they go along. By the time they get to the end it is really being done mainly by themselves… by the end the student should be functioning like we do as colleagues. (I20 – Engineering)

What do you, your supervisors or your peers have to say about this view?

……

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LEARNING TO RESEARCH IS SEEN AS FOCUSSING

It is about pursuing mature, world-class expertise.

Some key ideas associated with this view are: Pursuing a passion, aiming to be the world's expert, developing into a mature researcher and colleague, embodying research, internal processes, shouldering responsibility for the research, 'hitting a gear'.

Something I've said to students for many years now is that they should be the world's foremost authority in the narrow area of their research by the time they complete. (I12-1 – IT)

I think it's got to do with if the student has really found a question that they are passionate about, that they have got a lot of energy for… I have actually seen things… go in directions that I didn't expect, and in fact didn't even agree with… if I have a feeling that it academically or intellectually passes muster, then I allow them to take it in that direction. (I16 – IT)

What do you, your supervisors or your peers have to say about this view?

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LEARNING TO RESEARCH IS SEEN AS CONTRIBUTING

It is about exploring positive impact on others.

Some key ideas associated with this view are: Coming to understand the impact of research on society.

To create ground-breaking systems that help other people. (W2)

the ability to reflect very effectively, on their processes to improve them, to be able to contribute better to society. (I2 – Engineering)

What do you, your supervisors or your peers have to say about this view?

……

……

LEARNING TO RESEARCH IS SEEN AS STRETCHING

It is about being stretched into new areas.

Some key ideas associated with this view are: Expanding into new areas, big changes, cutting edge.

It's the esoteric thoughts that you really need in research. You need the wacky thoughts, "Why don't we try looking at it this way?" If you're not comfortable, you're only going to say things that are safe. If you are going to bother doing research, you may as well not make it incremental. (I13 – Engineering)

It's nice to build on people's strengths but is it really developing them in the best way? Is it stretching them? ... With the very good student our relationship was such that we could talk about half formed ideas and as you were talking about them you could clarify something together. Whereas, if it's a student that is not up to that level, if you have a half formed idea and you start talking about it you probably just confuse them and they end up thinking that you don't know what you're talking about. Whereas, for a student who is more experienced to be talking about something that's half baked is probably exciting because it means that you really are close to that cutting edge where you're still forming things. (I14 – IT)

What do you, your colleagues or your students have to say about this view?

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SUPERVISORY ROLES

Supervisors see themselves as filling different roles.

These roles are not 'styles', they are not meant to represent 'typical stances', instead they demonstrate the range of options available to supervisors which may be adopted through a candidature.

THREE TYPES OF SUPERVISORY ROLES

Types of supervisory roles

Types of roles	*Examples*
Directing The directing roles emphasise the supervisor's input into the candidacy.	• Manager • Director
Collaborative The collaborative roles emphasise supervisors working with students as equals.	• Partner • Colleague
Responsive The responsive roles emphasise meeting students' needs. They are adopted as required throughout the candidature.	• Mentor • Coach

More examples of roles belonging to these groups appear on the next page.

I distinguish between my role at the beginning of a candidacy and my role towards the end. I expect that my role will change from a more directing one at the beginning to a more collaborative one as the journey continues.

About Directing

The first year is very important, especially the first half year, I think. So normally at the very beginning I ask the students to make a plan. I want them to control their time because we have three months before something is due. I ask them to give me a plan, month by month, and the first month week by week. The first month is normally the literature review. They give me the list of what they are reading and I give them some papers. I control what they are reading to make sure they are on the right track. (I11)

About Collaborating

I usually say to students when we start out that I see this as a shared journey, and that it's a destination I've not been to before and so I can't lead them or guide them in some sense on the journey because I haven't been there either, in terms of that particular area of research that we are trying to find the answer to. Based on my own experience of research, I like to think that I'm "wise to the ways of the forest", so I guide them in that spirit but I've not been to this particular destination either. (I6)

DIRECTING ROLES

MANAGER – ensures milestones are met, quality is high and students' expectations are moulded.

Being clear about milestones… So, reports are submitted, deadlines are met, progress is sufficient and if it's not to initiate the appropriate action… it's important that students do not spend too much time on areas that are not going to be productive for the PhD. (I9 – IT)

The manager is the person who can really make sure that that program will end, the candidate will do the thesis and will graduate. (I22 – IT)

DIRECTOR – points the student in the right direction, indicates the source of answers to their questions and provides early intellectual content.

it's a lot about helping them find a project and setting a realistic goal... It's very much at the front working through the particular pathway (I5 – Engineering)

It's not answering the questions for them. It's pointing them in the right direction… It's being wise to the ways of the forest rather than having the answer myself (I6 – IT)

COLLABORATIVE ROLES

PARTNER – adopts a position as a fellow-learner alongside the student, forming a research team.

It's a research partnership, it's not a student-teacher relationship in the same way it is as an undergraduate student. I've learned an awful lot from PhD students and from Masters students. (I8 – IT)

COLLEAGUE – treats the student as an equal academic, with high expectations of the student as a significant contributor to the project.

It's great to have someone skilled because it means they can work semi-independently and get a lot of research done. Your relationship is starting off a lot more as colleagues than as supervisor and student. (I14 – IT)

RESPONSIVE ROLES

COACH – involvement in the project at a high (visionary and planning) level only.

The role of the coach should be to help the coachee's thinking rather than to solve problems for the coachee. (W2)

MASTER – orienting the student to the profession.

I actually have a responsibility which is more than just the research and the production of the thesis. I think I have a responsibility to try to do general professional development… The PhD is one of the few areas of life where we still have the masterpiece… your thesis is going to the examiners, the existing Masters, who judge it to see if you should be admitted to their ranks. (I5 – IT)

I want to make sure that they're ready, so that when they get out there they are not green and when they get out there the big bad world doesn't scare them too much. (I17 – Engineering)

MENTOR – instilling the 'spirit of the discipline' and developing their colleagues.

As mentor you are going to build that person to become a true research professional in the discipline that they have chosen. So, your job is to instil in them the spirit of the discipline. I have a test -- when they have gone to the bikkies and drinks at the graduation ceremony… Would you say, "That person is really my colleague, they are not my student any more but now my colleague"? That's what I call a mentoring role. (I22 – IT)

I don't think it is necessarily teaching them specific skills because they know a lot of that stuff already. It's more as a guide or mentor, to challenge them and support them, to take them to the next level. I see it more as a collegial relationship and just giving them a lot of feedback and support. (I20 – Engineering)

ADVISOR – answering questions raised by the student.

I like the American term "adviser". Obviously there is a lot of experience that I've got as a researcher, to guide and advise them and help them understand how the research community works. (I19 – IT)

EXAMPLE – modelling to the student how research may be done.

I do not pretend that I am going to teach them every possible way of research, rather because I consider myself quite a successful researcher I believe that the way I do it works and therefore I try to teach it the way that it can be done. A good way of doing it... (I1 - IT)

NETWORKER – supplying contacts and a breadth of resources.

Give them initial contacts, people to talk to. (I3 – Engineering)

To see the dots, to bring the dots together. If someone sits in my room and says, "I am currently facing this situation."…We try to open these doors. We understand that the student doesn't have this kind of network and we want to find the best case for their scenario. . It's facilitating the journey and providing access to people, to organizations, to empirical evidence. (I12-2 – IT)

PRESALES CONSULTANT – looking for the next opening in the discipline.

I feel like I'm a presales consultant, you go and chase the next topic, maybe big brain, what is the next wave. (I12-2 – IT)

SUPPORTER – encouraging, providing damage control at crisis points.

I like them to take ownership of their thesis and so I do a lot of supporting so they can own the thesis, that they can own their work, but it also means that I do not take responsibility when they don't meet deadlines. If they choose not to make the deadline, then they accept the consequences from that. It doesn't mean that I berate them, I help them to recreate the deadline, but they know that it has consequences on their other timeframes that they have made. So, I am pretty clear that it is their thesis and it is their journey and I am their number one supporter but it is theirs. (I20 – Engineering)

EDITOR – providing proofreading and argument advice.

Editing is still there… in the early stages of the work and suggesting improvements, but not telling them how to write because everyone has their own personal writing style. However, I'm now finding with the international students that this is a very blurred line. I'm finding sentences that make no sense and I'm having to figure out what the students are trying to say and making suggestions. (I8 – IT)

NURTURER – discovering and building on the student's interests and abilities.

It's not about having rules about what I do, it's about trying to meet the needs of each student. (I9 – IT)

For the students often it's a matter of finding what they are able to do easily and what they are able to do with a certain effort and what they are completely unable to do. … So, you have to lead them along a certain path and find out their skills, because they arrive with certain skills and you have to build on these skills, rather than building everything from scratch, because that is difficult in the time span that you have. (I4 – Engineering)

CUSTODIAN – monitoring their content knowledge.

I feel like I'm a custodian for the content but not for the bureaucratic process (I16 – IT)

QUALITY ASSURER – ensuring they come up to expected academic standards.

Every now and then I have to add some intellectual content, … trying to ascertain if what they've done has actually been reasonable, that the ideas they've developed actually have a good, sound physical basis, or a mathematical basis, that the experiments have actually been done reasonably and that they've actually used shielded cables and they haven't just seen noise in the measurements and things like that. (I3 – Engineering)

COUNSELLOR – helping the student maintain motivation.

Pressure can be effective but it can also be counter-productive. …so there has to be a lot of motivation in there as well, a building of motivation in conjunction with deadlines. (I12-1 – IT)

We tried to pick topics of interest to industry where we wanted some momentum. We wanted the students from day one to think it was the best thing since sliced bread that they're working on. I tend to say that to every single student, "This is the most important topic in our field." This is a kind of feel-good factor. (I12-2 – IT)

INTERMEDIARY – liaising between the student and university systems.

We've got one with IP issues at the moment, so we're all learning as we go. In that particular case I believe I'm an intermediary between the student who is externally funded and the university… So, you've got to be a bit of an advocate for the student but you also have to make sure that you are doing things within guidelines. (I17 – Engineering)

PARENT – keeping an eye on the students' personal needs.

It's almost a parenting role to make sure they're happy, and if you can look human to them then they're more likely to come and tell you their problems. (I5 – Engineering)

I also tend to be a bit of a mother as well. I will offer personal advice where one is aware that there is a girlfriend crisis... I might be old-fashioned but where there's a student in front of you in tears because his girlfriend has left him, you've got to give him a hug and you've got to just be mother. (I5 – IT)

Some students are really quite stubborn. What you need to do then is almost like a parent and explain that you really need to do some things that you don't really like. (I16 – IT)

FRIEND – providing for social needs.

I like to be friends with my students, if I can help them with issues that they have and leave it at the level they want to leave it at. Some students like to talk to me more about their personal situations and some don't and so it's whatever they want to do… Sometimes it can be a concern, how students are doing, especially if they have come from overseas or from outside town. So I try to make sure that they are in with a community here. (I19 – IT)

SAFARI LEADER – supporting the student as they branch out.

one of your roles is that guidance -- the safari leader. There are all sorts of distractions along the way and that's up to your judgement… Some theses you just guide all the way through but most do strike off on their own, particularly half way through or towards the end of the second year. Then you just wait to see what you're going to get, really. (I21 – IT)

THE NINE PEDAGOGIES

UPHOLDING ACADEMIC STANDARDS

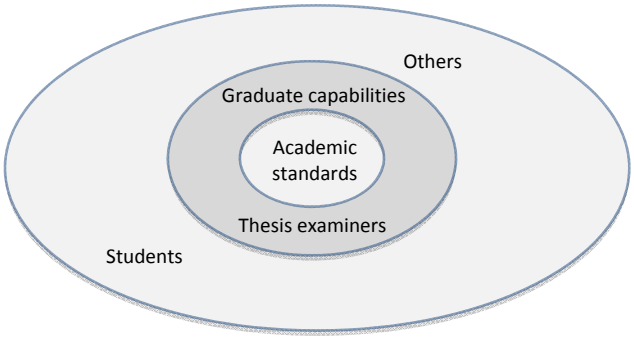
Teaching research students is thought of as upholding academic standards. Supervisors ensure the expectations of the academic community (discipline and institutional) are met, concerning the standard of work produced and the time within which it is produced.

Something I've said to students for many years now is that they should be the world's foremost authority in the narrow area of their research by the time they complete… If they are going to be rigorous enough and deep enough, then they have to be relatively narrow and it's not a stretch to assume that they will be the world's foremost authority in that narrow area. (I12-1 – IT)

The first six months I spend quite a lot of time… doing all the usual boring things, the Confirmation, etc. (I22 – IT)

Supervisors –

- **Direct attention towards:** established academic standards.
- **Consider the following aspects relevant to supervision:** MOPP; graduate capabilities; external examiners; timelines; thesis as a deliverable; journals; conferences.
- **Are less likely to consider:** Students and others.
- **See supervision from:** the supervisor's perspective.



Upholding academic standards

PROMOTING LEARNING TO RESEARCH

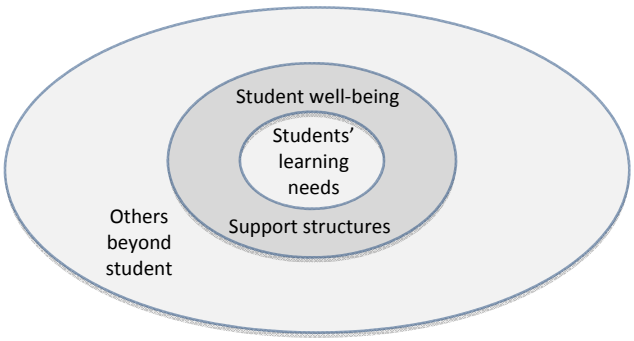
Teaching research students is thought of as promoting learning to research. Supervisors perceive and respond to the needs of the student, to enable the student to reach the end goal of their candidacy.

As they say, "Every child is different", so every student is different. So, each one is a new learning in how to do it… I try to work in detail with the students. (I16 – IT)

There's a big difference between the beginning and the end of the PhD. They should be independent, functioning PhDs at the end... By the time they get to the end it is really being done mainly by themselves. (I20 – Engineering)

Supervisors –

- **Direct attention towards:** students' learning needs.
- **Consider the following aspects relevant to supervision:** Student's mental, physical and emotional well-being; institutional support structures.
- **Are less likely to consider:** Others beyond the student.
- **See supervision from:** the student's perspective.



Promoting learning to research

VENTURING INTO UNEXPLORED TERRITORY

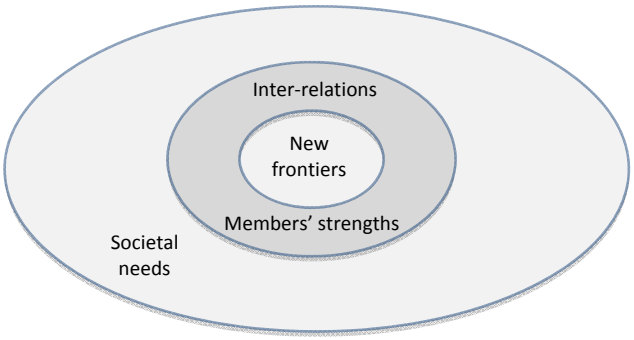
Teaching research students is thought of as venturing into unexplored territory. Supervisors form a research team whose members work together to discover the research agenda.

I expect them to learn about how to ask questions and think in a creative and expansive way that is not limited by what other people have said or done. (I9 – IT)

It's the esoteric thoughts that you really need in research. You need the wacky thoughts, "Why don't we try looking at it this way?"... If you are going to bother doing research, you may as well not make it incremental. (I13 – Engineering)

Supervisors –

- **Direct attention towards:** new frontiers.
- **Consider the following aspects relevant to supervision:** team inter-relations; team's strengths and weaknesses; new insights; non-standard approaches.
- **Are less likely to consider:** societal needs.
- **See supervision from:** the academic community's perspective.



Venturing into unexplored territory

PROMOTING THE SUPERVISOR'S DEVELOPMENT

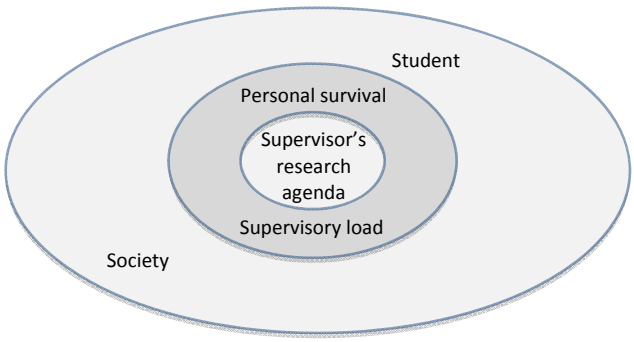
Teaching research students is thought of as promoting the supervisor's development. Supervisors pursue their established research objectives, determined by their personal and their team agendas.

generally the way I do work with students is that during the first year they are probably working as a research assistant, learning the ropes. This is what you have to do, you have to do the literature review and this is the kind of program you will have to write and this is how we are going to test it, etc. (I1 - IT)

I don't like the research assistant model… where I have ownership over the project and I tell them to go and do a certain analysis, to write up and then I clean it up myself… I like them to call some of the shots. (I17 – Engineering)

Supervisors –

- **Direct attention towards:** supervisor's research agenda.
- **Consider the following aspects relevant to supervision:** established agendas; existing network, in order to simplify supervision; leveraging past work; personal survival; hierarchy's expectations of supervisory load.
- **Are less likely to consider:** students and society.
- **See supervision from:** the supervisor's perspective.



Promoting the supervisor's development

ENABLING STUDENT DEVELOPMENT

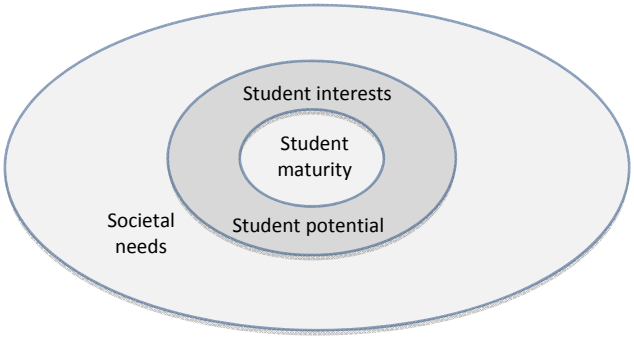
Teaching research students is thought of as enabling student development. Supervisors work towards student growth into academic and professional maturity.

Basically, an independent researcher so they can do all the things that they need to do. They can do their lit review, come up with a variety of solutions and then work on it. So, they will develop a level of independence. (I13 – Engineering)

one day they'll be known as 'Doctor Somebody' and… I still think that society tends to look at it in some certain way. They need to think about what this means socially and ethically to them. (I22 – IT)

Supervisors –

- **Direct attention towards:** student maturity.
- **Consider the following aspects relevant to supervision:** student weaknesses and strengths; student ambitions and interests; student potential.
- **Are less likely to consider:** societal needs.
- **See supervision from:** the student's perspective.



Enabling student development

CONTRIBUTING TO SOCIETY

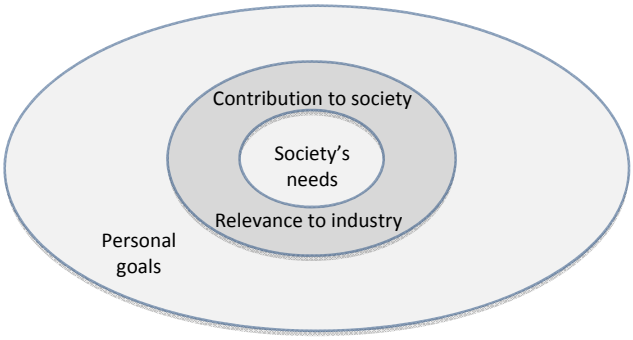
Teaching research students is thought of as contributing to society. Supervisors define research in terms of society's needs and work towards having positive social impact.

To create ground-breaking systems that help other people. (W2)

the ability to reflect very effectively, on their processes to improve them, to be able to contribute better to society. (I2 – Engineering)

Supervisors –

- **Direct attention towards:** society's needs.
- **Consider the following aspects relevant to supervision:** contribution to society; meeting others' needs; responsible scholarship; relevance to industry; potential to commercialise.
- **Are less likely to consider:** personal and student goals.
- **See supervision from:** the wider community's perspective.



Contributing to society

IMPARTING ACADEMIC EXPERTISE

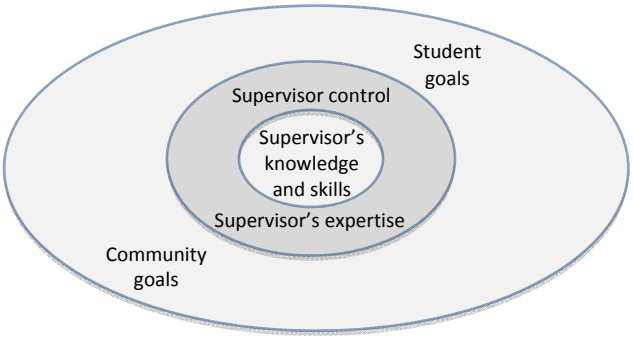
Teaching research students is thought of as imparting academic expertise. Supervisors convey their expertise in the knowledge and skills needed for research.

What I expect them to learn... is how to conduct research... using my approach… because I consider myself quite a successful researcher I believe that the way I do it works. (I1 - IT)

my approach is to lead the student to a path that they find successful by using, as much as possible, my experience on one side and their desire to succeed on the other side. I mean, I always give to the students a certain basis of what I know. (I4 – Engineering)

Supervisors –

- **Direct attention towards:** supervisor's knowledge and skills.
- **Consider the following aspects relevant to supervision:** supervisor's area of interest and expertise; institution's facilities; control over the candidacy.
- **Are less likely to consider:** student and community goals.
- **See supervision from:** the supervisor's perspective.



Imparting academic expertise

DRAWING UPON STUDENT EXPERTISE

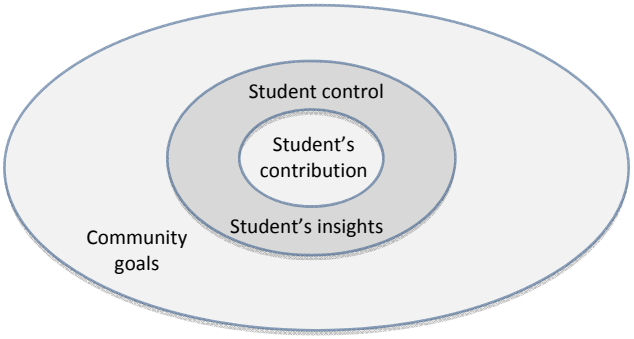
Teaching research students is thought of as drawing upon student expertise. Supervisors build from existing student abilities and interests in order to pursue a mutually defined question.

the most important thing I think is to actually get the student to work their way into the topic and to identify what they think are the key issues that they need to resolve. (I3 – Engineering)

It's a research partnership… I've learned an awful lot from PhD students and from Masters students. Some of the suggestions you hear… are excellent. So, I learn a lot from the students themselves. (I8 – IT)

Supervisors –

- **Direct attention towards:** student's contribution.
- **Consider the following aspects relevant to supervision:** student interests and expertise; student insights; student as a source of knowledge; student control.
- **Are less likely to consider:** community goals.
- **See supervision from:** the student's perspective.



Employing student expertise

FORMING PRODUCTIVE COMMUNITIES

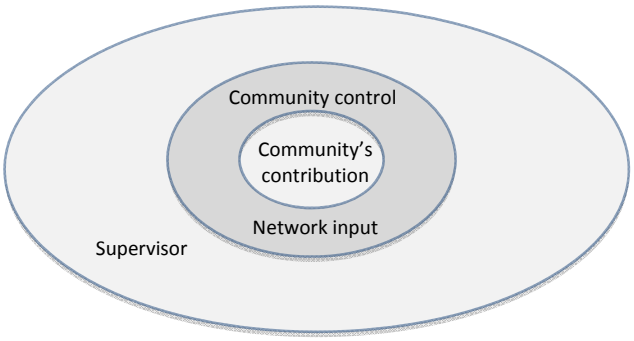
Teaching research students is thought of as forming productive communities. Supervisors draw key stakeholders together into an active network of contributors to the research endeavour.

you create a bidirectional flow whereby you have a team or this organization has a very dense network in itself. You have all these dots, but all these dots are very well connected. I want that there is a maximum density in this network. (I12-2 – IT)

Invite students to meet with industry partners (W1)

Supervisors –

- **Direct attention towards:** community's contribution.
- **Consider the following aspects relevant to supervision:** networks (of students, supervisors and industry partners) in order to introduce alternative points of view; multiple interactions; communication; exploration of possibilities; relinquishment of central control.
- **Are less likely to consider:** supervisor's goals.
- **See supervision from:** the research community's perspective.



Forming productive communities

STRATEGIES MAPPED AGAINST SUPERVISORY ROLES

What might happen if supervisors adopt different roles (*Supervisory roles* section) whilst using the same strategy (*Strategies* section) for supervision? The table below shows examples of how students and supervisors might interact.

Strategies and roles

Strategy	Directing	Responsive	Collaborative
A. Creating groups	Supervisors and students meet regularly and student input is assessed by the supervisors.	Supervisor holds a seminar on a special topic when they identify a need in their students.	Supervisors and students meet to identify needs and offer solutions.
B. Creating structure	Supervisor establishes clear expectations about responsibilities.	Supervisor reviews student work e.g. monthly plan, TOC.	Supervisor and student devise a research plan together.
C. Generating outputs	Supervisor requires reports, papers, articles and ultimately a thesis, with specific outputs at specific times.	Supervisor seeks opportunities which will advance the student in areas of need e.g. conferences at a realistic level.	Supervisor and student agree on joint outputs and work towards them together.
D. Creating space	Supervisor plans down-time for the student.	Supervisor withholds an answer, so the student can discover it.	Supervisor and student talk around a wide range of interests to discover each other's contributions.
E. Establishing collaboration	Supervisor assigns the student to a research team, comprised of other students.	Supervisor introduces student to industry and other partners, according to student interests.	Supervisor and student establish a working relationship, with give and take on both sides. Supervisor and student learn together.
F. Focusing on the big picture	Supervisor conceptualises the research as a contribution to society.	Supervisor discusses student's career aspirations and project goals with the student and their influence on the candidature.	Supervisor's and student's strengths and weaknesses are acknowledged as influencers of the candidature.
G. Negotiating expectations	Supervisor expresses their expectations clearly e.g. "it is your thesis". Supervisor only accepts high-quality candidates.	Supervisor identifies student expectations and responds to them.	Supervisor and student discuss their mutual expectations.
H. Pursuing established programmes	Supervisor manages students so they pursue the supervisor's established agenda.	Supervisor perceives student interest in established programs and directs their attention to them.	Supervisor and student have established common interests which they pursue as a team.

LEARNING OUTCOMES MAPPED AGAINST SUPERVISORY ROLES

What might happen if supervisors adopt different roles (*Supervisory roles* section) whilst striving for the same learning outcomes (*Learning outcomes* section) to supervision?

The table below shows examples of how students and supervisors might interact.

Learning outcomes and roles

Learning outcomes	Directing	Responsive	Collaborative
1. Topic expertise	Supervisor chooses the topic and imparts their insights.	Supervisor helps students discover their passion.	Supervisor and student pursue a topic of mutual interest and contribute equally.
2. How to get resources	Supervisor chooses the literature and monitors student's understanding. Supervisor assesses the logic of student's insights.	Supervisor supports the student as they navigate unsteadily.	Supervisor looks to student to discover new literature and see new connections.
3. Independence	Supervisor designs student experiences to compel autonomous action.	Supervisor encourages student initiatives as they occur.	Supervisor and student fulfil responsibilities interdependently.
4. Contributing to society	Supervisor refers to ethics committee requirements.	Supervisor discusses ethical implications of research with student.	Supervisor and student are attentive to the ethical implications of the project.
5. Teamwork skills and membership in a research community	Supervisor organises research group around a common topic and requires joint work, to a defined timeline.	Supervisor is alert to teamwork possibilities but lets the student choose whether to engage or not. Supervisor monitors progress against a timeline.	Supervisor and student form a productive team.
6. Publishing	Supervisor sets the goal of the number of publications and rank of journals/conferences.	Supervisor suggests publishing opportunities and edits student's work extensively.	Supervisor and student write and conceptualise together.
7. Developing as a professional	Supervisor presents the implications in society of holding doctoral qualifications.	Supervisor offers experiences related to the student's career interests.	Supervisor and student work together on activities relevant to the student's career goals.

HAVE YOU USED THE FOLLOWING RESOURCES THAT HELP?

RESEARCH STUDENTS CENTRE

The Research Students Centre is found at: http://www.rsc.qut.edu.au/

The Research Students Centre includes:

- a Graduate Capabilities resource with links to skill sets and online training for students;
- a number of project plan proformas that are also useful in creating structure and generating outputs, found in the section on the PhD;
- information about setting up a scholarship, procedures and policy, online resources, and accreditation and training.

AUSTRALIAN TECHNOLOGY NETWORK LEARNING EMPLOYMENT APTITUDES PROGRAM (ATN LEAP)

ATN LEAP is found at: http://www.rsc.qut.edu.au/studentsstaff/training/qutresources.jsp

It includes the following modules:

- Project Management
- Entrepreneurship
- Leadership and Communication
- Research Commercialisation
- Public Policy

ADVANCED INFORMATION RETRIEVAL SKILLS (AIRS)

AIRS is found at:
http://www.library.qut.edu.au/learn/airs/index.jsp (for students)

Student AIRS can be taken as an online course or as a face-to-face course. It is a compulsory coursework subject for PhD students. It includes information on:

- literature reviews;
- library services and information resources;
- bibliographic databases;
- advanced internet searching, management techniques and tools;
- current awareness strategies; and
- Endnote.

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OTHER RESOURCES FROM THE SAME PROJECT

This resource is part of a series around the pedagogy of supervision in the technology disciplines. The papers form part of an Australian Learning and Teaching Council Fellowship project conducted by ALTC Associate Fellow, Professor Christine Bruce, QUT.

Papers around the pedagogy of supervision in the technology disciplines

Resource type	Title
Papers	1. Bruce, C. & Stoodley, I. (2009) *Fellowship plan and conceptual framework.* (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT.
	2. Bruce, C., Stoodley, I. & Gasson, S. (2009) *A review of the conversations and their content*. (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT.
	3. Bruce, C. & Stoodley, I. (2009) *A pedagogical framework for the technology disciplines*. (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT.
	4. Bruce, C., Bell, J., Gasson, S., Geva, S., Kruger, K., Oloyede, K., O'Shea, P., Stoodley, I., Raymond, K. & Wissler, R. (2009) *Summary and recommendations.* (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT.
Resources	5. Bruce, C. & Stoodley, I. (2009) *Resource for supervisors.* (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT. 6. Bruce, C. & Stoodley, I. (2009) *Student resources for the use of supervisors.* (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT.
Workshops	7. Bruce, C. & Stoodley, I. (2009) *Workshop for supervisors.* (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT.
Cases	8. Bruce, C. & Stoodley, I. (2009) *Cases from the technology disciplines*. (Towards a pedagogy of supervision in the technology disciplines series.) Brisbane: QUT.

The papers are freely available from:

- the ALTC Exchange site, http://www.altcexchange.edu.au/pedagogy-supervision-technology-disciplines; and
- the QUT electronic publications archive, http://eprints.qut.edu.au/ .